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Nutritional Status and Work Fatigue

(Study at Night Bus Drivers in South and West Sulawesi)

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Abstract

This research aimed to evaluate the risk of traffic accidents factors related to the working fatigue of the night-shifted bus drivers. The Type of the research was analytic observation and exploration events during the drivers working with "hybrid design study" that is the combination between the research cohort cross-sectional elements and elements in which the cross-sectional elements were clustered to a cohort of research that output was unknown. The samples were 46 drivers who were selected in the inclusive criteria. Respondents were examined on their health condition (blood pressure, pulses, reaction hemoglobin, hematocrit, ferritin, BMI, blood sugar in time, lungs car and they were monitored along the ways to Reviews their destinations, and results were recorded in a log book. Data is used univariate analysis technique by describing; characteristics of the respondents, the bivariate technique by using cross tabulation and multivariate technique by using logistic regression. The result shows that the hemoglobin, hematocrit, serum ferritin contents, BMI (Body Mass Index) nutrition intake, and lungs capacity do not have significant relationships with reaction time. Hemoglobin, hematocrit content, BMI and nutrition intakes do have significant relationships with the symptoms of drossiness. Together with hematocrit, hemoglobin, BMI and nutrition intakes give a significant contribution to the occurrence of drowsiness on the night-shifted bus drivers. The drivers are suggested to have regular eating patterns, sleeping patterns and fulfill necessities to maintain sufficient liquid Reviews their stamina during driving.

Keywords: Nutrition status, working fatigue, reaction time, drowsiness, night-shifted bus drivers

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1. Introduction

Factors associated with traffic accidents are strongly influenced by controlling the vehicle (driver). Conditions of accident-prone driver is the driver that impaired nutritional status, general health conditions and driver behavior as well as other factors. In addition, vehicle and environmental factors in this case the road and weather conditions played a role [1]. Data from the Indonesian National Police South Sulawesi Regional Directorate of Traffic, the number of traffic accidents for 2006 1,127 cases, 1,493 cases in 2007 and 1,872 cases in 2008. From these data the 681 people who died in 2006, 938 people for a year 2007, 958 people in 2008. from these data indicate an increase from year to year[2]. Factor of fatigue due to work varies greatly, can be a physical problem, responsibility, and the pain of health conditions, nutrition [3]. The causes of fatigue are also very complex and interconnected between each other. The causes of fatigue include physical work activities, mental, non-ergonomic work station, work attitude, static work, monatomic, extreme working environments, needs less calories, work-break time is not right. In addition, the effect of workload, role conflict, role ambiguity, and awards received authority can affect fatigue [4]

Fatigue can be regarded as a public health problem due to various reports of accidents on land, including the train crash, fatigue factors contribute to accidents [5]. Nearly 70% of the causes of accidents is driver drowsiness and fatigue. Referring to the results of research to the National Sleep Foundation, 55 percent of traffic accidents caused by drowsiness [6]. This study aimed to assess the nutritional status and the bus driver's fatigue at night.

2. Materials and Method

2.1. Location, Population and Sample

This research was conducted at the departure terminal transport buses, all the way Makassar-Mamuju (return), Makassar-Palopo (return), Makassar-Tana Toraja. (return). The population is all drivers of public transport (buses) which operates in South Sulawesi and West Sulawesi. Samples are drivers of public transport (buses) which operates Makassar-Mamuju, Makassar- Palopo, Makassar-Tana Toraja as a sample of 46 respondents were taken by purposive sampling [7].

2.2. Data collection

Measurement tools used Reaction Time Reaction Timer is L77-L77-type EP 354, Lakassidaya. The reaction time is by using light stimuli. Tool is portable measuring 23.5 x 13.5 x 6 cm and consists of 3 units. Examination measured by observation sleepy several indicators (such as yawn, rub the eyes, etc.) during the trip that is recorded in the log book. Nutritional intake of food is measured by the Food Recalls and Food Frequency. Levels of hemoglobin, serum ferritin, hematocrit checked in the laboratory. Body Mass Index (BMI) was measured by weighing (weight scales tool) and height (microtoise). Supporting other data as an indicator of blood sugar glucose in the blood is measured in the laboratory. Blood pressure and pulse checked before and after work (driving). Blood pressure was measured by lung capacity measurements by means of a spirometer (Spirolab). Characteristics of Respondents and Variable Data Smoking measured by questionnaires.

2.3. Data Analysis

Data of food recall of 24 hours and food frequency processed with W food program, while the other variable data processed with SPSS. Data were analyzed with univariate form of frequency distribution, the bivariate correlation analysis and multivariate logistic regression. All those result are elaborated in term of narration and table distributions.

3. Results

Respondent characteristics were observed to find a valid data relate the respondent daily life and all their activity relate to the driving routinely, as described below;

Table 1. Data Characteristics of Respondents on Transport Driver oRoute on Makassar-Mamuju, Makassar-Palopo, Makassar-Tator

Characteristics	Mean	Deviation Standard
Age	36.72	8.2
Body weight	66.87	10.69
Height	164.06	6.29
IMT	24.87	3.50
Sistolik 1	120.00	12.82
Diastolik 1	82.71	6.92
Sistolik 2	114.78	13.66
Diastolik 2	81.85	9.62
Pulse 1	75.70	8.84
Pulse 2	75.13	8.80
Hemoglobin	15.99	1.22
Hematokrit	46.43	3.06
Ferritin Serum	298.46	
Nutrition intake	74.23	16.27
GDS	117.11	62.32
Reaction time 1	381.00	148.14
Reaction time 2	396.45	144.33

It can be seen in table 1 that of the 46 respondents the average age was 36.72 years with 66.87 kg body weight, and the average height of 164.06 cm. Then your body mass index average of 24.87, blood pressure before and after still within normal limits. Then pulse before driving an average of 75.70 / min, pulse after driving 75.13 / min. In terms of nutritional status in this case the average hemoglobin level 15 997 mg / dl on average hematocrit 46.43% average ferritin 365.13 mg / dl, and when issued extreme value, then the value of the average

ferritin be 298.46.mg/ dl. When compared to the value recommended by the WHO (<90 mg / dl), the average serum ferritin is above normal. Blood glucose values on average was 117.1, and reaction time before driving an average of 381.00 millisecond (this indicates that the driver before working in conditions of mild fatigue) and after driving the average reaction time is longer be 396.45 millisecond which means the level of driver fatigue increased, while the average BMI was 24.87.

Table 2. Distribution of Respondents by Nutritional Status on Drivers Route on Makassar-Mamuju, Makassar-Palopo, Makassar-Tator

Nutrition Status (IMT)	Route							
	Mamuju		Palopo		Tator		Total	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Normal	9	50.00	1	6.25	2	16.67	12	26.07
BW over								
Pra-obesity	4	22.22	7	43.75	2	16.67	13	28.26
Obesity 1	4	22.22	5	31.25	8	66.66	17	36.96
Obesity 2	1	5.56	3	18.75	0	0	4	8.69
Total	18	100	16	100	12	100	46	100

Table 2 shows that the driver who has the body weight status of excess were 44 respondents, consisting pra-obesity 13 respondents (28.26%) with pra-obesity category, 17 respondents (36.96%) with the obese category I and 4 respondents with obese category II.

Table 3. Distribution of respondents by sleep duration / day on Motorists Route on Makassar-Mamuju, Makassar-Palopo, Makassar-Tator

Sleep duration	Mamuju		Palopo		Tator		Total	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
≤ 2 hour	1	5,5	1	6,25	1	8,3	3	6.52
3 - 4 hour	12	66,7	12	75	8	66,7	32	69.57
5 - 6 hour	4	22,2	3	18,75	2	16,7	9	19.57
> 6 hour	1	5,5	0	0	1	8,3	2	4.34
Total	18	100	16	100	12	100	46	100

The Table shows that drivers generally only have time to sleep for 3-4 hours / day with percentage (69.56%)

Table 4. Distribution of respondents by experienced drowsiness while working as a driver at route on Makassar-Mamuju, Palopo Makassar, Makassar-Tator.

Sense	Routes							
	Mamuju		Palopo		Tator		Total	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Heal fell *(eyefal)*	4	22,2	6	37,5	2	16,7	12	26,09
Sleepy	10	55,6	9	56,25	10	83,3	29	63,04
Not	4	22,2	1	6,25	0	0	5	10,87
Total	18	100	16	100	12	100	46	100

Table 4. shows that all drivers have experienced drowsiness on all routes, Mamuju (55.6%), Palopo (56.25%) and Tator (83.3%). while the driver who had experienced very sleepy until the head fell (eye fall) were 12 drivers (26.09%).

Table 5. Distribution of respondents by sleep patterns on transport drivers route on Makassar-Mamuju, Makassar-Palopo, Makassar-Tator.

Sleep pattern	Mamuju		Palopo		Tator		Total	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Morning – mid day	2	11,11	4	25	2	16,7	8	17,39
Mid day – afternoon	16	88,89	12	75	10	83,3	38	82,61
afternoon – mid night	0	0	0	0	0	0	0	0
mid night – morning	0	0	0	0	0	0	0	0
Total	18	100	16	100	12	100	46	100

Table 5 shows that drivers sleep patterns were 38 of the 46 drivers into the sample (82.61%) is at mid day – afternoon.

Table 6 signs noted logged sleepy assessed book with signs of drowsiness in the form of volatile and events that follow after evaporate e,g., driver's conduct sudden braking or wiping the face, shaking his head, open the window, smoking, storytelling and so forth. Sign the form sleepy yawn, wiping the face, shaking his head (head movement) as recommended AAA Foundation for Traffic Safety.

Research results recorded logged books, 46 drivers (25 primary and 21 backup drivers) sign evaporate occurred in 19 primary and 7 drivers backup. While there is no sign as many as 6 people yawn. In the log book also

recorded no signs of drowsiness such as wiping the face / eyes, scratching his head, smoke, open a window which can be considered as measures to overcome the existing drowsiness.

Table 6. Distribution frequency of the signs of drowsiness based on observations and recorded in the log book

Sign	Mamuju (%)	Palopo (%)	Toraja (%)	Note: (range)
Yawning	44.44	62.5	83.33	1- 6 times
Sudden break	77.78	75	83.33	1- 6 times
Touch face / eye	27.78	56.25	41.67	1- 6 times
Head movement	50	56.25	50	1- 6 times
Horning	83.33	62.5	83.33	1- 6 times
Passing	38.87	56.25	66.67	1- 6 times
Talking	83.33	81.25	100	1-6 times

4. Discussion

4.1. Relationship between nutritional status with fatigue (reaction time)

In this study, the hypothesis was based on the assumption that there is a relationship between nutritional status as measured by levels of hemoglobin, hematocrit, serum ferritin and body mass index with fatigue as measured by reaction time and signs of drowsiness. With a Pearson correlation test results obtained that are statistically insignificant with values ($p > 0.05$) there is no significant relationship between the levels of hemoglobin, hematocrit, serum ferritin and BMI with reaction time. This is in line with research that suggests that the relationship between hemoglobin levels with no significant reaction time [8.9]. By categorizing variables (based on the average value), then tested with Chi-Square (Fisher's Exact test) showed that statistically there was no significant relationship between nutritional status (hemoglobin, hematocrit, serum ferritin and IMT) with reaction time (after work), it is seen from the value ($P > 0.05$). Likewise, after each of the variables (hemoglobin, hematocrit, serum ferritin and BMI), when the average value (the mean) minus 1 times and 2 times the standard deviation. Similar results were obtained when added 1 times and 2 times the standard deviation.

Reaction time is the time between the administration of stimuli arising single until the onset of the arising response to that response [10]. The reaction time is a simple reaction on single excitatory or reactions that require coordination. The reaction time is a physical emotional component is instantaneous reaction. There was no correlation between the levels of hemoglobin, hematocrit, serum ferritin with reaction time could have been influenced by the presence of things that affect the measurement of reaction time, among others, the reaction of

each individual, motivation, given the type of stimuli, age, gender [11]. Similarly, according Granjean (2000) on the central nervous system are activation (activator) and inhibition (inhibitors) 3. System is sympathetic activation that stimulates the nerves to work. While the nature of the parasympathetic inhibition that inhibits a person's ability to react. If the effect of the activation system is stronger, then the body is in an idle state to respond to the stimulus. However, if the system is more robust inhibition and activation systems is low, then the body will experience a decline in readiness to react to a stimulus. So it can be said that the reaction time is more influenced by the state of the nervous system. In this study, examination of the reaction time using light stimuli. Each stimuli that come from the eyes will raise the level of activation of the reticular and forwarded to the optical cortex to stimulate and increase the preparedness and occurs in response to light stimuli. The results of the analysis between nutrient intake with a reaction time of no significant association. It is very likely due to things that affect the measurement of reaction time and also nutrition. Nutrient intake as measured by 24-hour food recall very likely influenced by matters relating to a person's memory and perception, especially concerning dose / size of the food eaten before. While the reaction time as has been explained that the timing of this reaction is instantaneous reactions are influenced by physical emotional and psychological.

4.2. Relationship between lung capacity with fatigue (reaction time)

The results of the analysis using Chi-Square between lung capacity with fatigue (reaction time) showed no significant correlation (P> 0.05). The amount of oxygen that can be inhaled into the lungs to the maximum a person can be determined by measurement of lung capacity. Conjunction with the reaction time is indirectly, because the amount of oxygen that can be inhaled into the lungs are not all used for metabolism, because it is still influenced by VO max (ability to use oxygen by the body) are also still affected heart rate and cardiac output. The reaction time is instantaneous state, which is checked at the time of finished work. There is no significant relationship between lung capacity with reaction time. It is very likely influenced by things in the measurement of lung capacity and also the measurement of reaction time. Lung capacity is influenced by anatomical and physiological state of the lungs. In addition, influenced by a person's ability to inhale and exhale as well as the perception of a person to be examined [12].

4.3. Relationship between smoking status with reaction time

The results of the analysis with chi-square test between smoking status with the reaction time was not statistically significant (p> 0.05), means that smoking status was not associated with reaction time. Smoking can cause changes in the structure and function of the respiratory tract and lung tissue [13]. Upper respiratory tract will undergo hypertrophy and increased mucus glands (hyperplasia). In the lower respiratory tract will cause inflammation and will cause constriction and mucus buildup. With the disruption of the respiratory system, it will affect the ability of a person's lungs or lung capacity. The measurement results reaction time is the time that occurs between giving up the excitatory response to these stimuli. It was explained that this reaction time is a physical emotional reaction that occurs rapidly. There is no significant relationship between lung capacity with the reaction time is very likely to be influenced by things that affect reaction time inspection of the condition and type of emotions stimuli. The things that affect lung capacity checks the condition of the respiratory system, especially the alveoli, the ability of individual inspiration and expiration.

4.4. The relationship between hemoglobin levels with symptoms of drowsiness

By categorizing hemoglobin levels above the median with risky (not normal) to above the midpoint and not risky if it is below the average value. Told sleepy yawn when the discovery that will follow one of the actions taken by the driver (head rubbing, head movement, etc.) then the test results Fisher's Exact Test p value <0.05, which means there is a significant association between hemoglobin levels in touch with symptoms of drowsiness. Drowsiness (Drowsy) is characterized by a set of components in the form of signs such evaporates (yawning), eye / eyelid fall (eye fall / closure), flash (blink) as the movements of the face (facial action) and also their movements of the head (head movement) [14]. Yawning is a physiological reflex because of the head (brain) needs more oxygen [15] vaporizes a sense of sleep [16]. There was a significant association between hemoglobin levels with drowsiness, can be explained that the value of hemoglobin cause drowsiness. Hemoglobin is the oxygen-carrying compound in the blood cells that can be measured in a number of chemical Hb / 100 ml of blood.

This measure can be used as an index of the oxygen-carrying capacity of the blood. The function of hemoglobin is transporting CO2 from the tissues to the lungs for breathing air excreted into and carry O2 from the lungs to the cells of the network. Oxygen is transported from the lungs to the tissues by hemoglobin approximately 97% (about 19.4 milliliters per 100 ml of blood). Time passes through the capillary network this number was reduced to 14,4ml (PO2,40 mmHg, hemoglobin saturated, 75%). Thus, under normal conditions is approximately 5 milliliters of oxygen transport to the tissues by each 100 ml of blood [17].

4.5. The relationship between hematocrit with symptoms of drowsiness.

The results of the analysis with Fisher's Exact test no significant association between hematocrit with drowsiness symptoms (p <0.05). Hematocrit is the volume of red cells separated from plasma by turning in a special tube whose value is expressed in percentage (%). After centrifugation, the red cell column height was measured and compared with the original high full blood. Percentage of red cell mass at the original blood volume is the hematocrit. Because full blood formed essentially by red blood cells and plasma, after centrifugation percentage of red cells provide an indirect estimate the number of red blood cells per 100 ml of whole blood (thus, in turn, is an indirect estimation of hemoglobin). Thus hematocrit depend in part by the number of blood cells merah18. Hematocrit value is the most often used to determine the number of red blood cells in a milliliter of blood or the ratio between red blood cells with other blood components. Therefore hematocrit is the percentage of red blood cells, then it also shows the blood concentrations. The results of the analysis of hemoglobin levels significantly associated with drowsiness, then so is the case with hematocrit was no significant relationship with sleepy. It can be explained that the hematocrit is the expression of a number of red blood cells. Hemoglobin is the oxygen-carrying compound in the blood cells that can be measured in a number of chemical Hb / 100 ml of blood. This measure can be used as an index of the oxygen-carrying capacity of the blood. When the number of red blood cells or hemoglobin is low, the capacity of the blood to transport O2 will go down, so with a low hematocrit.

4.6. The relationship between serum ferritin with symptoms of drowsiness

The results of the analysis of the test Fisher's Exact Test was no significant association between serum ferritin with symptoms of drowsiness. The amount of ferritin released into the blood in proportion to describe the amount of iron deposits in the liver [18]. Thus, measurement of serum ferritin indirectly assess iron in the blood. Red blood cells is a complex form of celebration which is formed by metallic iron (Fe) with hem and globin cluster. Synthesis of the complex involves two kinds of enzymes that ALAD (Amino Acid leuvilinic Dehydrate) and a cytoplasmic enzyme. This enzyme is active at an early stage during the synthesis and circulating red blood cells take place. Thus, iron is essential for the formation of red blood cells. When iron deficiency can cause a decline in the production of red blood cells. The lack of correlation between serum ferritin with sleepy very likely caused by things that affect serum ferritin include consumption of foods containing iron and inhibitors of iron absorption.

4.7. Relationship between Body Mass Index (BMI) with symptoms of drowsiness

The results of the analysis with chi square test showed no significant association between BMI with symptoms of drowsiness ($p < 0.05$). Categories for BMI is normal when BMI <22.99 and 22.99 ≥. Ratio normal when body weight per height indicates the relationship of weight to height used to assess overweight and obesity in adults. IMT is also termed the Quetelet index, is calculated as weight (kg / height (m^2) [19], BMI is correlated with obesity. But it does not reflect the distribution of fat deposits in the body. Obesity (overweight) will increase the size and number of adipose cells and furthermore can cause metabolic disorders. Apart from being a fat storage, adipose cells would produce biologically active molecules (adipokines) such as pro-inflammatory cytokines, anti-inflammatory hormones and other biological substances. Obesity also causes the expression of pro-inflammatory cytokines increase in circulation so that resulting in vascular wall inflammation [20,21,22]. With the onset of vascular wall inflammation is very likely to cause disruption also oxygenation to the tissues, including brain tissue.

4.8. The relationship between lung capacity, smoking status with symptoms of drowsiness

Lung capacity considered normal and not normal, if there is obstruction and restriction. Test results Fisher's exact test was no significant association between lung capacity ($p > 0.005$) with symptoms of drowsiness. Measurement of lung capacity to determine the volume of breathing air which is the ratio between FEV1 (forced expiratory volume -1) with FVC (forced vital capacity), said to be normal if the FEV1 / FVC> 75%. The amount of respiratory air volume is influenced by several factors such as the size of the respiratory system, the ability and habit of expiration and inspiration, as well as a person's health condition, the movement of the thorax wall [23]. In addition, a person's lung capacity was also influenced by physical characteristics, age, height, weight [17]. there was no association between lung capacity can be explained very likely influenced by the things that affect the measurement of lung capacity among other conditions of the individual, the ability of a person's inspiration and expiration. Smoking status in this case is the smoking habit categorized someone who smokes or not, and if smoking can count the number of cigarettes / day, a period of time (longer smoke which is expressed in years). Smoking can cause changes in lung structure and function. The main function of the lungs

that is for the exchange of gases between the blood and the atmosphere gas exchange. It aims to provide oxygen to the tissues and remove carbon dioxide. Needs oxygen and carbon dioxide is constantly changing according to one's level of activity and metabolism, respiration can still maintain oxygen and carbon dioxide content of the [17].

4.9. Time Drowsiness

In Table 3 the main driver in a variety of majors getting sleepy in the average time span between 2 to 3 hours from the start of driving, while the auxiliary driver getting sleepy on the average time span between 0.5 to 1, 5 hours after replacing the main driver. Facts in the UK, public transport buses distance between the city of Dundee in Scotland to London within 600 miles, taken within a period of 11 hours and the bus stop every 2 hours to change the driver, where a replacement driver on the bus from a bus stop. Replacement driver performed 5 times.

5. Conclusion

This study concluded that as many as 84.78 a night bus driver experiencing fatigue and as much as 60.86% experiencing drowsiness. The results showed that the levels of hemoglobin, hematocrit, body mass index, nutritional intake is associated with the incidence of drowsiness at night bus driver, while the levels of hemoglobin, hematocrit, ferritin, BMI, lung capacity, smoking status with reaction time. Taken together with hematocrit, BMI, nutrition, then hematocrit were significantly able to predict the incidence of drowsiness. Taken together with hemoglobin, nutritional intake, BMI, the hemoglobin was significantly able to predict the incidence of drowsiness. It is recommended to the driver while maintaining health, especially diet and sleep patterns, in order to stay in shape in a state fit to drive and when it was getting sleepy should not force to continue the journey, keeping the needs of fluid by drinking more water, and to the carriers can pay attention to the health of the driver by means of the initial medical examination and periodic examinations.

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